

## DIGITAL MODEM DEVICE AND DIGITAL EXCHANGE

Patent Number: JP2241244  
Publication date: 1990-09-25  
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Requested Patent: ☒ JP2241244  
Application Number: JP19890060927 19890315  
Priority Number(s):  
IPC Classification: H04L12/50  
EC Classification:  
Equivalents:

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### Abstract

**PURPOSE:** To prevent the deterioration of a signal by reducing the number of times of analog/digital conversion and digital/analog conversion by providing a means to digital-convert mutually communication data and a digital encoded signal.

**CONSTITUTION:** When a request to connect a data communication terminal 13a and an analog public line network 17 arises, a digital exchange 12 connects a trunk 15a for a digital line connected to the requested data communication terminal 13a to the trunk 15c for the digital line, and connects the trunk 16 for an analog line to the trunk 15d for the digital line respectively. Thus, a digital MODEM device 11 is loop-connected digitally to the digital exchange 12, and exchanges mutually the communication data of the data communication terminal 13a and the digital encoded signal by the code of PCM or ADPCM, etc. Thus, a digital/analog conversion circuit and an analog/digital conversion circuit are eliminated.

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## ⑫ 公開特許公報(A) 平2-241244

⑬ Int. Cl.<sup>3</sup>

識別記号

庁内整理番号

⑭ 公開 平成2年(1990)9月25日

H 04 L 12/50

7830-5K

H 04 L 11/20

1 0 3 A

審査請求 未請求 請求項の数 5 (全6頁)

⑮ 発明の名称 デジタルモデム装置およびデジタル交換機

⑯ 特 願 平1-60927

⑰ 出 願 平1(1989)3月15日

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## 明 細 書

## 1. 発明の名称

デジタルモデム装置およびデジタル交換機

## 2. 特許請求の範囲

1. データ通信に使用される回線接続機器であって、通信データと、デジタル符号化信号とを相互にデジタル変換する手段を有することを特徴とするデジタルモデム装置。

2. デジタルモデム装置をデジタル回線用トランクに接続し、

該デジタルモデム装置は、通信データと、デジタル符号化信号とを相互にデジタル変換する手段を有するものであることを特徴とするデジタル交換機。

3. サービストランクとしてデジタルモデムトランクを設け、

該デジタルモデムトランクは、通信データと、デジタル符号化信号とを相互にデジタル変換する手段を有するものであることを特徴とするデジタル交換機。

4. 上記デジタル変換手段は、マイクロプロセッサとデジタル変換プログラム用メモリとを有し、上記デジタル変換プログラム用メモリに格納するデジタル変換プログラムの種類により上記デジタル変換の種類を設定することを特徴とする請求項1記載のデジタルモデム装置、または、請求項2もしくは3記載のデジタル交換機。

5. 上記デジタル変換手段は、2以上のデジタル変換プログラムを格納するメモリと、該デジタル変換プログラムを実行する1または2以上のマイクロプロセッサとを備え、実質的に複数のモデム機能を有することを特徴とする請求項1記載のデジタルモデム装置、または、請求項2もしくは3記載のデジタル交換機。

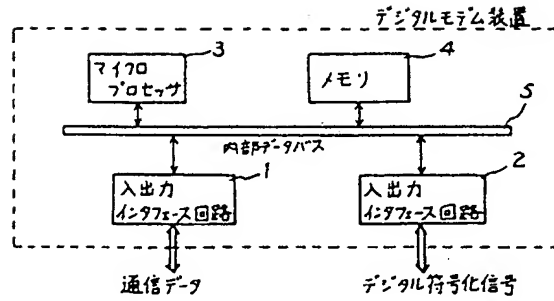
## 3. 発明の詳細な説明

(産業上の利用分野)

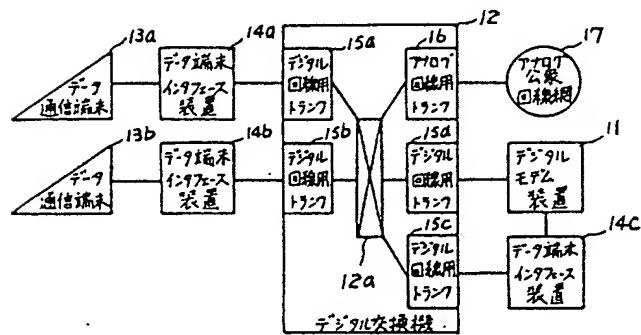
本発明は、データ通信等に使用されるモデム装置、並びに、該モデム装置を内部機能の一部として保有するデジタル交換機に関する。

(従来の技術)

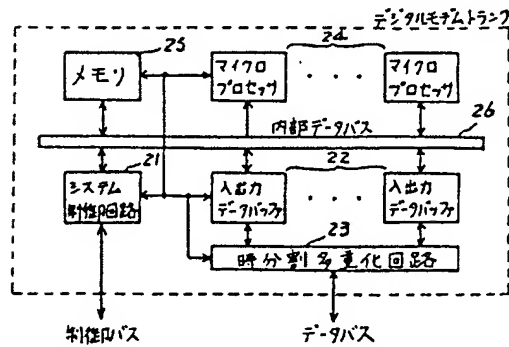
第 1 図



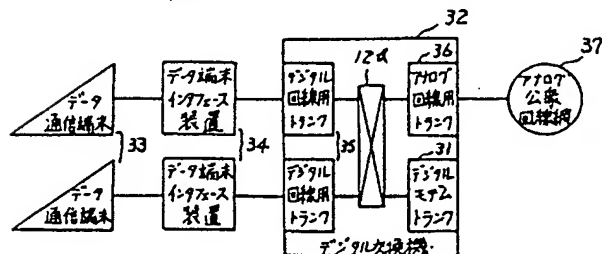
第 2 図



第 3 図



第 4 図



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JAPANESE PATENT OFFICE  
PATENT JOURNAL (A)  
KOKAI PATENT APPLICATION NO. HEI 2[1990]-241244

Int. Cl. <sup>5</sup> :	H 04 L 12/50 H 04 L 11/20
Sequence No. for Office Use:	7830-5K
Filing No.:	Hei 1[1989]-60927
Filing Date:	March 15, 1989
Publication Date:	September 25, 1990
No. of Claims:	5 (Total of 6 pages)
Examination Request:	Not filed

DIGITAL DEVICE AND DIGITAL EXCHANGE

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[There are no amendments to this patent.]

Claims

1. A type of digital device characterized by the fact that the digital device is line connecting equipment used in data communication, and it has a means for implementing digital conversion between communication data and digital encoded signals.

2. A type of digital exchange characterized by the following facts:  
a digital modem device is connected to a trunk for a digital line,  
the digital modem device has a means for implementing digital conversion between communication data and digital encoded signals.
3. A type of digital exchange characterized by the following facts:  
a digital modem trunk is set as a service trunk,  
and the digital modem trunk has a means for implementing digital conversion between communication data and digital encoded signals.
4. The digital modem device described in Claim 1 or the digital exchange described in Claim 2 or 3 characterized by the fact that said digital conversion means has a microprocessor and a memory for a digital conversion program, and the type of said digital conversion is set corresponding to the type of digital conversion program stored in said memory for a digital conversion program.
5. The digital modem device described in Claim 1 or the digital exchange described in Claim 2 or 3 characterized by the fact that said digital conversion means has a memory for storing two or more digital conversion programs, and one or more microprocessors for execution of said digital conversion programs, and it essentially has plural modem functions.

#### Detailed explanation of the invention

##### Industrial application field

This invention pertains to a type of modem device for data communication, and a type of digital exchange that has said modem device as a portion of its internal function.

##### Prior art

In the prior art, a modem device is used as equipment for line connection in data communication. It performs modulation/demodulation of digital communication signals and analog signals of telephone lines. One modem device is used for each data terminal unit.

As described in Japanese Kokai Patent Application No. Sho 63[1988]-38366, equipment having a modem function, such as the communication adaptor of a personal computer, or a modem device is loop-connected to a digital exchange, and it can be shared by plural data terminals or personal computers connected to the digital exchange by means of a terminal interface device. Also, plural types of modem devices can be connected to a single terminal, and they are switched for use corresponding to the type of connected line. This function is commonly known as a modem pool function.

### Problems to be solved by the invention

In the aforementioned prior art, a conventional modem device is connected to the digital exchange as is. Consequently, in the analog public line connecting portion of the digital exchange, the analog input/output side connecting portion of the modem device, and the modem device, three rounds of analog/digital conversion and digital/analog conversion are carried out in all. Consequently, the signal quality may degrade, and the hardware requirements is large. This is undesired.

The objective of this invention is to provide a type of digital device characterized by the fact that it has the modem device digitalized so as to prevent degradation in signal by reduction in the number of rounds of analog/digital conversion and digital/analog conversion when connection is made to a digital exchange, etc., and plural types of modem functions can be realized on the same hardware by setting a program so as to reduce the hardware requirement.

Another objective of this invention is to provide a type of digital exchange that contains said modem.

### Means to solve the problems

In order to realize the aforementioned objectives, in the digital modem device of this invention, instead of a conventional analog signal, a digital signal using PCM, ADPCM or another code is input/output, and the entire digital device is digitalized.

That is, this invention provides a type of digital device characterized by the fact that the digital device is line connecting equipment used in data communication, and it has a means for implementing digital conversion between communication data and digital encoded signals.

Also, this invention provides a type of digital exchange characterized by the following facts: a digital modem device is connected to a trunk for a digital line, the digital modem device has a means for implementing digital conversion between communication data and digital encoded signals.

For the digital exchange of this invention, the following constitution is preferred: a digital modem trunk is set as a service trunk, and the digital modem trunk has a means for implementing digital conversion between communication data and digital encoded signals.

Said digital conversion means may have a microprocessor and a memory for a digital conversion program, and the type of said digital conversion is set corresponding to the type of digital conversion program stored in said memory for a digital conversion program.

It is preferred that said digital conversion means have a memory for storing two or more digital conversion programs, and one or more microprocessors for execution of said digital conversion programs, and that it essentially have plural modem functions. With this constitution, it is possible to realize plural types of modem function on a single hardware item.

As a result, the digital exchange can include a modem pool function as an internal function inside the system.

### Operation

The digital modem device of this invention is a type of digital/digital signal converter. By means of a program for digital conversion, it is possible to perform mutual digital/digital conversion between the communication data from a data terminal, etc. and a digital coded signal, such as PCM, ADPCM, etc., corresponding to the analog signal for a public line. As a result, when connection is made to a digital exchange, there is no need to convert the signal temporarily to analog form as would be needed in the prior art, there is no degradation in signal, and the quality can be improved.

Also, the digital modem device of this invention has a constitution composed of a microprocessor and a memory for a digital conversion program. Consequently, it is possible to realize plural modem functions on a single hardware item by changing the digital conversion program on the memory for a digital conversion program, for example, by means of a program for a 1200-baud modem and a program for a 4800-baud modem.

Consequently, by having the digital modem device of this device as a portion of the internal function, the digital exchange can include a modem pool function inside the system.

### Application examples

In the following, this invention will be explained in detail with reference to application examples illustrated by figures.

Figure 1 is a block diagram illustrating the basic constitution of the digital modem device in an application example of this invention.

In the figure, (1) represents an input/output interface circuit of the communication data; (2) represents an input/output circuit of the digital coded signal; (3) represents a microprocessor; (4) represents a memory; and (5) represents an internal data bus.

Communication data from a data communication terminal or the like are input/output to/from the digital modem device by input/output interface circuit 1, and a digital coded signal using PCM, ADPCM, etc. is input/output to/from the digital modem device by input/output interface circuit 2.

According to the digital conversion program in memory (4), microprocessor (3) converts input communication data to a digital coded signal and outputs it from input/output interface circuit (2). Also, it converts a digital coded signal to communication data and outputs same from input/output interface (1). Said memory (4) can store two or more digital conversion programs.

As a result, by making appropriate changes for the program, it can function just as if plural modems existed.

Figure 2 is a system structural diagram illustrating an application example of a digital exchange system used in a modem pool function using the digital modem device shown in Figure 1.

In the figure, (11) represents the digital modem with constitution shown in Figure 1; (12) represents a digital exchange; (12a) represents a switch network; (13a) and (13b) represent data communication terminals; (14a), (14b) and (14c) represent data terminal interface devices; (15a), (15b), (15c) and (15d) represent trunks for a digital line; (16) represents a trunk for an analog line; and (17) represents an analog public line network.

Data communication terminals (13a) and (13b) are digitally connected to trunks (15a) and (15b) for a digital line of digital exchange (12) through digital terminal interface devices (14a) and (14b).

When there is a request for connection of data communication terminal (13a) or (13b) to analog public line network (17), digital exchange (12) connects trunk (15a) or (15b) for a digital line and connected to requested data communication terminal (13a) or (13b) to trunk (15c) for a digital line, and it connects trunk (16) for an analog line to trunk (15d) for a digital line.

As a result, digital modem device (11) digitally makes a loop connection to digital exchange (12), and it realizes mutual exchange between the communication data of data communication terminal (13a) or (13b) and a digital coded signal using PCM, ADPCM, or another code. The digital encoded signal makes mutual conversion with an analog signal on analog public line network (17) on trunk (16) for an analog line.

In the prior art that uses a conventional modem device instead of digital modem device (11), trunk (15d) for line is a trunk for an analog line, and this trunk for an analog line is connected to the modem device by means of an analog circuit. In this application example, the overall system is digitalized by means of digital modem device (11) and trunk (15d) for a digital line. Since there is no need to have a digital/analog converter and analog/digital converter, it is possible to reduce the hardware requirement and to alleviate signal degradation.

Also, in this application example, instead of data terminal interface devices (14a), (14b) and (14c) and trunks (15a), (15b) and (15c) for a digital line, one may adopt a trunk for connecting data terminals and having functions of both the devices and trunks. Also, in this application example, a plurality of each of trunks, interface devices and digital modem devices may be set.

Figure 3 is program diagram illustrating an application example, in which the digital modem device of this invention is used as a service trunk having a modem pool function for digital exchange. In the following, this will be referred to as a digital modem trunk. Figure 4 is a



system structural diagram illustrating an application example of a digital exchange system in which the digital modem trunk shown in Figure 3 is contained as a portion of the internal function of the digital exchange, so that a digital exchange system having the same function as that shown in Figure 2 is formed.

As shown in Figure 3, (21) represents a system controller that controls this digital modem trunk overall; (22) represents an input/output data buffer of the communication data and digital encoded signals; (23) represents a time-division multiplexer connected to the data bus of the digital exchange; (24) represents a microprocessor for performing digital/digital conversion; (25) represents a memory for storing a digital conversion program, etc.; and (26) represents an internal data bus.

In Figure 4, (31) represents a digital modem trunk with the constitution shown in Figure 3; (32) represents a digital exchange; (32a) represents a switch network; (33) represents a data communication terminal; (34) represents a data terminal interface device; (35) represents a trunk for a digital line; (36) represents a trunk for an analog line; and (37) represents an analog public line network.

In the digital exchange, the digital modem trunk shown in Figure 3 is positioned as a type of service trunk, and it is controlled through the control bus of the digital exchange.

System controller (21) is made of a dedicated or general-purpose microprocessor, and it controls the entire digital modem trunk. Time-division multiplexer (23) and input/output data buffer (22) are circuits connected to a channel time shared data bus in the digital exchange for input/output of data. These circuits are the same as for a conventional trunk for a line. Usually, there are plural input/output data buffers (22), and simultaneous connection to the data bus of the digital exchange in plural channels is possible.

Together with this, one or plural microprocessors (24) are used to perform plural digital/digital conversions in a parallel way. As a result, it is possible to realize the functions of plural modem devices by means of the digital modem trunk shown in Figure 3. That is, the modem pool function of plural modem devices can be realized on a single trunk.

Also, in this case, in memory (25), one or plural programs for digital conversion are present, and they are shared by means of microprocessor (24). However, their combination can be changed by means of system controller (21). Also, the digital exchange can change the program for digital conversion in memory (25). As a result, for plural modem functions realized on the digital modem trunk, the combination of types and number can be changed at will using the same hardware.

Also, it is possible to set memory (25) corresponding to plural microprocessors (24). In this case, it is preferred that memory portions corresponding to the various microprocessors and a shared memory portion be set.

In the digital exchange system shown in Figure 4, in a single trunk, digital modem trunk (31) can realize the plural functions of the loop shown in Figure 2 composed of digital modem device (11), data terminal interface device (14c), and trunks (15c) and (15d) for a digital line.

As shown in Figure 4, when there is a request for connection of data terminal (33) to analog public line network (37), trunk (35) for a digital line and trunk (36) for an analog line are both connected to digital modem trunk (31) by digital exchange (32). Mutual digital conversion is performed between communication data and digital encoded signals by digital modem trunk (31) using PCM, ADPCM, etc.

In this case, digital modem trunk (31) can realize plural modem functions at the same time, for example, it can realize functions corresponding to four 1200-baud modems and two 4800-baud modems at the same time. The modem functions and the number can be programmed in digital exchange (32). In this application example, instead of data terminal interface device (34) and trunk (35) for a digital line, one may also realize the function by means of a trunk for data terminal connection having functions of both of them.

#### Effect of the invention

As explained above, according to this invention, in a modem device connected to a digital exchange, the signal is not subject to analog/digital conversion and digital/analog conversion. Consequently, it is possible to improve the signal quality. Also, since the overall system is digitalized, the integration degree of the circuit can be increased, and the system can be simplified. As a result, it is possible to reduce the cost of the device.

Also, in this invention, plural types of modem functions can be realized on a single hardware item, and it is possible to contain a modem pool function in the digital exchange. Consequently, it is possible to reduce the hardware requirement and cost of this device.

As a result, it is possible to realize the modem pool function of plural modem devices on one trunk.

#### Brief description of the figures

Figure 1 is a block diagram illustrating the basic constitution of the digital modem device in an application example of this invention. Figure 2 is a system structural diagram illustrating an application example of the digital exchange system using the digital modem device shown in Figure 1 and for use in a modem pool function. Figure 3 is a block diagram illustrating an application example in which the digital modem device of this invention is formed as a digital modem trunk. Figure 4 is a system structural diagram illustrating an application example of a digital exchange system in which the digital modem trunk shown in Figure 3 is contained as a portion of the internal function of the digital exchange.

1	Communication data input/output interface circuit
2	Digital code input/output interface circuit
3, 24	Microprocessor
4, 25	Memory
5	Internal data bus
11	Digital modem device
12, 32	Digital exchange
13a, 13b, 33	Data communication terminal
14a, 14b, 14c, 34	Data terminal interface device
17, 37	Analog public line network
15a, 15b, 15c, 15d, 35	Trunk for digital line
16, 36	Trunk for analog line
31	Digital modem trunk

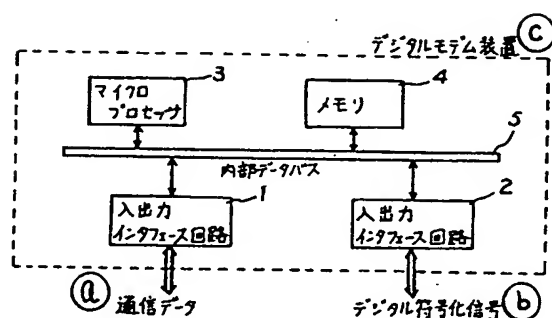


Figure 1

Key:	1	Communication data input/output interface circuit
	2	Digital code input/output interface circuit
	3	Microprocessor
	4	Memory
	5	Internal data bus
	a	Communication data
	b	Digital encoded signal
	c	Digital modem device

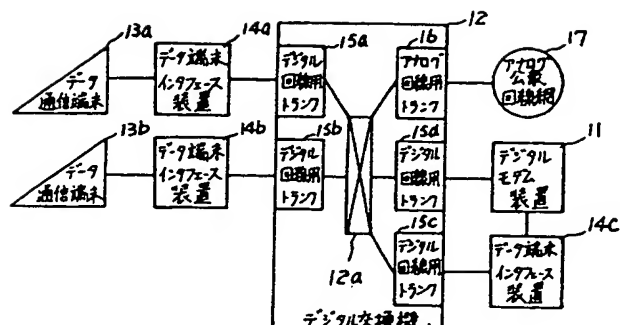


Figure 2

- Key:
- |                    |                                |
|--------------------|--------------------------------|
| 11                 | Digital modem device           |
| 12                 | Digital exchange               |
| 13a, 13b           | Data communication terminal    |
| 14a, 14b, 14c      | Data terminal interface device |
| 15a, 15b, 15c, 15d | Trunk for digital line         |
| 16                 | Trunk for analog line          |
| 17                 | Analog public line network     |

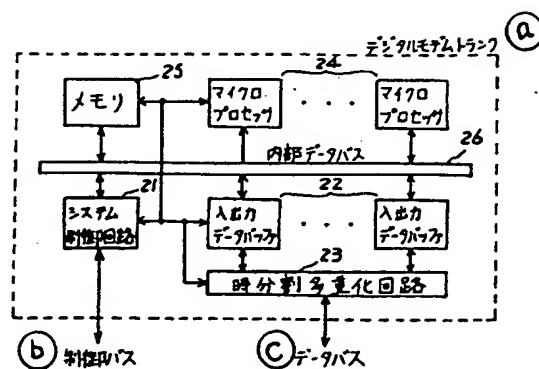


Figure 3

- Key:
- |    |                           |
|----|---------------------------|
| 21 | System controller         |
| 22 | Input/output data buffer  |
| 23 | Time-division multiplexer |

- 24 Microprocessor
- 25 Memory
- 26 International data bus
- a Digital modem trunk
- b Control bus
- c Data bus

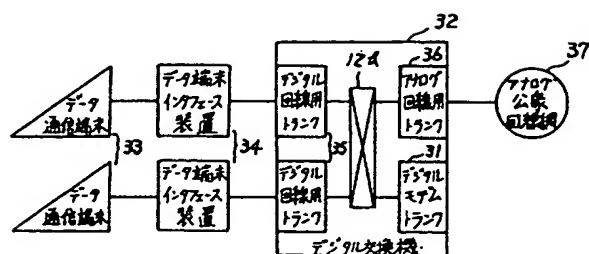


Figure 4

- Key:
- 31 Digital modem trunk
  - 32 Digital exchange
  - 33 Data communication terminal
  - 34 Data terminal interface device
  - 35 Trunk for digital line
  - 36 Trunk for analog line
  - 37 Analog public line network